



# SCIENCE AND TECHNOLOGY FOR THE 21ST CENTURY WARFIGHTER

■ 2005 REPORT SUPPLEMENT

# 2004

## World News

Rover lands on Mars

Two new chemical elements discovered

Construction at ground zero begins

Earthquake and tsunami devastate Indonesia

## ONR in the News

“Coalition chat line” breaks language barriers

Agile “brain-based” controller tested in unmanned vehicle

Free-Electron Laser reaches 10 Kilowatts

**Sea Coaster** christened

# ONR

**REAR ADMIRAL JAY COHEN**  
*20TH CHIEF OF NAVAL RESEARCH*



**REAR ADMIRAL WILLIAM "BILL" LANDAY, III**  
*21ST CHIEF OF NAVAL RESEARCH*

# LEADERSHIP

**BRIG. GEN. RANDOLPH D. ALLES**  
*VICE CHIEF OF NAVAL RESEARCH*



## DISCOVERY & INVENTION (\$713M - 40%)

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- *Naval scientific disciplines*
- *NRL/Warfare Centers*
- *National Naval Responsibilities*
- *Technical workforce sustainment*
- *High impacts/surprises*

## DIRECTED/PASS-THROUGH (\$330M – 19%)

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- *JFCOM's Joint Experimentation*
- *POM-04 PDM (except EM Rail Gun)*
- *PBD's and earmarks*

# Department of Navy

## S&T PORTFOLIO

# \$1,776M

## ACQUISITION ENABLERS (\$551M – 31%)

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- *FNC's (TOG Oversight)*
- *Warfighter Protect*
- *Capable Manpower (NI/N00T)*
- *LO/CLO (PMR 51)*

## INNOVATIONS (\$182M -10%)

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- *Innovative Naval Prototypes*
- *Swamp Works*
- *Tech Solutions*
- *SEA TRIAL*
- *Fleet/Force Response Programs*

# FY06

# MEETING CUSTOMERS' NEEDS THROUGH A DIVERSE SCIENCE & TECHNOLOGY PORTFOLIO

Naval Power Pillars	Expeditionary Maneuver Warfare	FORCENet	SEA SHIELD	SEABASE	SEA WARRIOR	SEA STRIKE
<b>Fleet/Force Customers</b>	MCWL N75 MARCORSYSCOM MARFOR, NAVFAC NCIS, DTRA, DHS SOCOM SPECWARCOM JNLW Directorate Army Research Lab	NETWARCOM N2 N71 SPAWAR ONI NRO NSA CIA NAVSEA NAVAIR	FLT ASW COM N76 N096 NAVMETOC CORE NOPP NOAA UNOLS TFASW, FASWC	NAVSURFOR N76 NAVSEA NAVSUBFOR NAVAIRFOR (for ship systems) USCG DOE	N1 Surgeon General USMC Medical Officer NETC CNP NIH BUPERS	NAVAIRFOR N75 NAVAIR Air Force Research Lab AMRDEC, Redstone AATD, FT Eustis NASA HQMC AVN
<b>Acquisition Leadership</b>	DASN LMW	DASN IWS/LMW/ AIR/C4I	DASN LMW/ IWS/AIR	DASN SHIPS/LMW	DASN SHIPS/C4I/ LMW	DASN SHIPS/ IWS/AIR
<b>ONR S&amp;T Departments</b>	Exp. Warfare & Combating Terrorism (Code 30)	C4ISR (Code 31)	Ocean Battlespace Sensing (Code 32)	Sea Warfare and Weapons (Code 33)	Warfighter Performance (Code 34)	Air Warfare and Weapons (Code 35)
<b>Discipline Providers</b>	Exp. Man. Warfare USMC STOs in multiple warfighting areas: <i>C4; ISR (w/31); Logistics; Human Perf; Trng &amp; Surv (w/34); Maneuver</i> MCM Warfare (w/32) Ground-based firepower Non-lethal weapons Combating terrorism Joint EOD Naval Specwar	Electronics Computer & Info sciences Radar/EO/IR Maritime sensors EM propagation & interaction Signal & image processing C3 Networking Surveillance EW Navig/Timekeeping	Oceanography Ocean Acoustics Coastal Geosciences Marine Geology & Geophysics Marine metrology Space MCM (w/30) ASW (w33,31) Signal Processing Maritime Sensing ASW & UUV's (w/33) Ocean eng. & marine systems	Chemistry Power & energy conversion Naval materials Non-linear dynamics Ship Structures Ship HM&E ASW & UUV's (w/32)	Cognitive science Neural science Behavioral science Social org./science Manpower, personnel & training Human factors Medical science Biomolecular science Biosystems Biomaterials CBWD	Physics Aerospace materials Energetics Surface & Air launched weapons Kinetic & Directed energy weapons Robotics UAV's Air Vehicles

# RELEVANT RESEARCH AND RESULTS...



E-Craft (Expeditionary Craft) Sea Lifter will demonstrate the functionality of a ship that can perform expeditionary logistics support and provide a multi-purpose, cargo and troop ship that performs efficiently at high speed, in ice, and in shallow waters, including beaching, and loading and unloading heavy equipment. The vertical position of the ship's center deck and the hull buoyancy both can be adjusted while underway.

**Quad Guard** is a lightweight, flexible armor system that helps protect the arms and legs, reducing the likelihood of severe injuries by protecting against smaller fragments generated by blast weapons and improvised explosive devices.



## The Hypersonic Flight Demonstration (HyFly) program's

goal is to flight-test key technologies enabling a long range, high-speed cruise missile that can cruise at speeds up to Mach 6. Recently, the HyFly program achieved the world's first flight of an air-breathing, scramjet-powered vehicle using liquid hydrocarbon fuel (JP-10) at speeds of Mach 5.5 and an altitude of 63,000 feet.



Sea Jet (Advanced Electric Ship Demonstrator) is a 133-foot vessel designed for testing new propulsion concepts with the goals of providing increased waterjet/shrouded propulsive efficiency, reduced acoustic signature, and improved maneuverability over previous Destroyer Class combatants in support of DD(X) special development.



The 50-knot Sea Fighter was turned over to

Third Fleet in August 2005 and is now homeported in San Diego. With a joint USN/USCG crew of just 26, Sea Fighter continues to undergo hull form and operational testing as part of a plan for risk reduction for the Navy's Littoral Combat Ship program and the Coast Guard's Deepwater program.



QuikClot, a fast-reacting blood clotting agent, has been deployed with over 250,000 Marines in combat and is now being deployed with the U.S. Air Force, the UK Ministry of Defence and

the Canadian military. A new formulation and application is a blood clotting sponge that can be packed in or around a wound.

The growing prevalence and sophistication of improvised explosive devices (IEDs), also called roadside bombs, is one motivating factor behind ONR's counter-IED basic research program. ONR's program, which came to be known informally as the "mini-manhattan" program, funds research that will help military forces detect, defeat, and destroy IEDs, and to change the calculus of this warfare by putting the enemy on the defensive.



The Ultra Armored Patrol Concept Vehicle was built to illustrate potential design and technology options that will increase the survivability and mobility of future combat tactile vehicles. An innovative faceted crew capsule provides better deflection of pressure waves from blasts than current configurations. The vehicle is slightly larger than the HMMWV and is diesel powered.



The Virtual At Sea Training (VAST) program provides the Navy and Marine Corps the capability to train effectively as a rehearsal tool with minimal environmental impact. In 2005, ONR developed and transitioned into operation two VAST training systems.

# YESTERDAY, TODAY AND TOMORROW

# FUTURE NAVAL CAPABILITIES

In 2005, the ONR **Future Naval Capability (FNC)** program was restructured to align with the pillars of the Chief of Naval Operation's and the Commandant of the Marine Corps' vision for the future—Naval Power 21—and to focus on providing Enabling Capabilities (ECs) to close warfighting gaps. The FNC program provides the best technology solutions to stated OPNAV requirements by bundling discrete but interrelated S & T products that deliver a distinctly measurable improvement within a five-year time frame. A three-star Navy and Marine Corps board of directors, the Technical Oversight Group, approves the FNCs based on their contribution to closing a warfighting capability gap, rather than on individual products. Thirty-five ongoing ECs are dedicated to the FNCs.

## **Sea Strike:**

Weapons, aircraft, and expeditionary warfare technologies that support projecting precise and persistent offensive power.

## **Sea Shield:**

Missile defense, anti-submarine warfare, mine countermeasures and fleet/force protection technologies that support projecting global defensive assurance.

## **Sea Basing:**

Logistics, shipping, and at-sea transfer technologies that support joint operational independence.

## **FORCEnet:**

Communications, networking, navigation, display, command and control, and decision support technologies that support the operational construct and architectural framework for naval warfare in the information age.

## **Enterprise and Platform Enablers:**

Cross-cutting technologies to lower acquisition, operations, and maintenance costs.

## **Sea Warrior:**

FNC-like program designed to support personnel recruiting, retention, training and medical readiness.

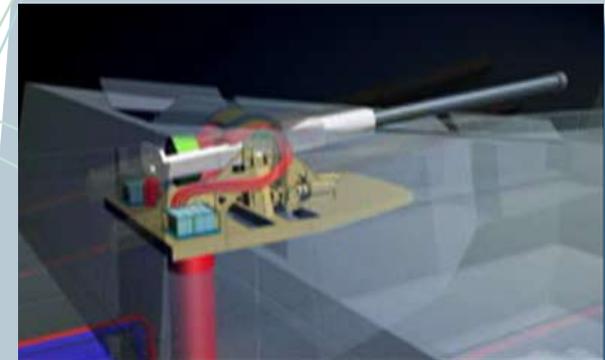
# INNOVATIVE NAVAL PROTOTYPES

**The Innovative Naval Prototypes (INP)** program is a revolutionary new way for the Navy to pursue its science and technology goals. This program is based on the previous success of other recent naval prototypes produced by ONR, such as the Sea Fighter and HyFly. The intent is to put significant investments into developing a small number of prototypes that will dramatically change how the Navy and Marine Corps team fights and wins wars.

The purpose of INPs is to develop prototype systems for technologies that still have high risk associated with them, but that will produce high payoffs if successful. They may be disruptive technologies that, for reasons of risk or radical departure from established requirements and concepts of operation, are unlikely to survive without endorsement from top leaders.

In 2005, ONR awarded contracts for the first INP, the electromagnetic railgun. This INP program's goal is to develop a prototype gun system that can continuously deliver precision rounds ashore from ships that are more than 300 nautical miles at sea. Although the rounds will contain little or no high explosive material, they will be able to inflict damage to their targets through their high impact velocity. The railgun system will use a very high current flow to create electromagnetic forces that launch projectiles at speeds greater than Mach 7. The projectile's trajectory will take it quickly out of the Earth's atmosphere so it will do most of its traveling beyond the thick atmosphere. When it re-enters the atmosphere it will be able to strike its target at velocities greater than Mach 5.

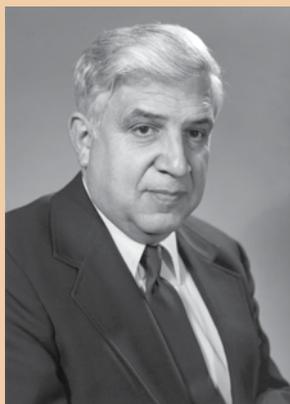
In addition to the railgun prototype, future INPs will focus on the dramatic, networked improvement of capabilities in persistent littoral undersea surveillance; software-enabled planar arrays to enhance ship stealth; the development of significantly enhanced capabilities for joint sea basing and ship-to-objective maneuver; improving the naval tactical use of space; and speed-of-light directed energy weapons.



# DISCOVERY TO DEPLOYMENT

**For 60 years, the work of ONR-funded researchers has been recognized by their peers, our nation, and the world through many prestigious prizes including the Nobel Prize, the National Medal of Technology, the National Medal of Science, and the Bower Award for Achievement in Science, just to name a few.**

## The “Father” of GPS



In November 2005, Roger L. Easton, the former head of the Naval Research Laboratory's Space Applications Branch, was awarded the

National Medal of Technology for his extensive pioneering achievements in spacecraft tracking, navigation and timing technology that led to the development of the NAVSTAR-Global Positioning System (GPS). The nation's highest honor for technology, the National Medal of Technology is awarded to individuals who embody the spirit of American innovation and who have advanced the nation's global competitiveness. Easton retired from NRL in 1980.

## ONR-SPONSORED NOBEL LAUREATES

- JOHN L. HALL - (PHYSICS, 2005)  
THEODOR W. HANSCH - (PHYSICS, 2005)  
ROBERT H. GRUBBS - (CHEMISTRY, 2005)  
RICHARD R. SCHROCK - (CHEMISTRY, 2005)  
PAUL LAUTERBUR - (MEDICINE, 2003)  
JOHN FENN - (CHEMISTRY, 2002)  
WOLFGANG KETTERLE - (PHYSICS, 2001)  
CARL WIEMAN - (PHYSICS, 2001)  
ERIC CORNELL - (PHYSICS, 2001)  
ERIC KANDEL - (MEDICINE, 2000)  
HIDEKI SHIRAKAWA - (CHEMISTRY, 2000)  
ALAN G. MACDIARMID - (CHEMISTRY, 2000)  
ALAN J. HEEGER - (CHEMISTRY, 2000)  
HERBERT KROMER - (PHYSICS, 2000)  
AHMED ZEWAIL - (CHEMISTRY, 1999)  
DANIEL C. TSUI - (PHYSICS, 1998)  
WALTER KOHN - (CHEMISTRY, 1998)  
HORST L. STÖRMER - (PHYSICS, 1998)  
WILLIAM D. PHILLIPS - (PHYSICS, 1997)  
RICHARD E. SMALLEY - (CHEMISTRY, 1996)  
GEORGE OLAH - (CHEMISTRY, 1994)  
RUDOLPH A. MARCUS - (CHEMISTRY, 1992)  
NORMAN F. RAMSEY - (PHYSICS, 1989)  
HANS DEHMELT - (PHYSICS, 1989)  
JOHN C. POLANYI - (CHEMISTRY, 1986)  
YUAN T. LEE - (CHEMISTRY, 1986)  
DUDLEY HERSCHBACH - (CHEMISTRY, 1986)  
HERBERT A. HAUPTMAN - (CHEMISTRY, 1985)  
JEROME KARLE - (CHEMISTRY, 1985)  
WILLIAM A. FOWLER - (PHYSICS, 1983)  
KENNETH WILSON - (PHYSICS, 1982)  
DAVID H HUBEL - (MEDICINE, 1981)  
ROALD HOFFMAN - (CHEMISTRY, 1981)  
NICOLAS BLOEMBERGEN - (PHYSICS, 1981)  
ARTHUR SCHAWLOW - (PHYSICS, 1981)  
HERBERT C. BROWN - (CHEMISTRY, 1979)  
HERBERT SIMON - (ECONOMICS, 1978)  
PETER MITCHELL - (CHEMISTRY, 1978)  
WILLIAM LIPSCOMB - (CHEMISTRY, 1974)  
PAUL J. FLORY - (CHEMISTRY, 1974)  
CHRISTIAN ANFINSEN - (CHEMISTRY, 1972)  
ROBERT SCHRIEFFER - (PHYSICS, 1972)  
LEON COOPER - (PHYSICS, 1972)  
GERALD EDELMAN - (MEDICINE, 1972)  
KENNETH ARROW - (ECONOMICS, 1972)  
HAR GOBIND KHORANA - (MEDICINE, 1968)  
GEORGE WALD - (MEDICINE, 1967)  
HALDAN HARTLINE - (MEDICINE, 1967)  
HANS BETHE - (PHYSICS, 1967)  
CHARLES H. TOWNES - (PHYSICS, 1964)  
GEORG VON BEKESY - (MEDICINE, 1961)  
MELVIN CALVIN - (CHEMISTRY, 1961)  
ROBERT HOFSTADTER - (PHYSICS, 1961)  
DONALD GLASER - (PHYSICS, 1960)  
SEVERO OCHOA - (MEDICINE, 1959)  
LINUS PAULING - (CHEMISTRY, 1954)  
FELIX BLOCH - (PHYSICS, 1952)

Bombs explode in London subway attack

Astronomers discover potential 10th planet

Hurricane Katrina strikes the Gulf Coast

**Sea Fighter** christened

High-volume expeditionary water purification system developed

Counter IED basic research efforts begin

Morphine alternative created

**Sea Jet** christened

Nanorobot fabrication makes ultrasmall sensors possible

World News

ONR in the News

2005

ONR



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